PATENT ABSTRACTS OF JAPAN

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(54) POLYMER ELECTROLYTE FUEL CELL

(57)Abstract:

PROBLEM TO BE SOLVED: To solve the problem that a minute gap can occur with an MEA in between at the peripheral part of a conductive separator plate in an assembled fuel cell stackresulting in probable shorting at the gap partif the maximum external dimension of the MEA is smaller than that of the conductive separator plateas well as the problem that a carbon separator plate is weak in strength.

SOLUTION: The insulation at the end part of a separator plate is assured by providing the layer of an electric-insulating material at the peripheral part on the

side contacting the MEA of the conductive separator platepreventing minute shorting between the separator plates. The strength of the separator plate is improved thanks to the layer of electric-insulating material. When constituting a cooling part with a cathode side separator plate and an anode-side separator platean engagement part using a protruding part and a recessed part is provided on the jointing surface of themfor easy alignment.

CLAIMS

[Claim(s)]

[Claim 1]An electrode of a couple which has a catalyst bed which sandwiches polymer electrolyte membrane and said polymer electrolyteAnd two or more electrolyte membrane-electrode conjugates which consist of a gasket arranged in a peripheral edge part of said electrodeTwo or more conductive separator plates which put in said electrolyte membrane-electrode conjugate in between and were laminated by turnsThe entrance side of fuel gas and oxidant gas which were opened for free passage and formed in said electrolyte membrane-electrode conjugate and a conductive separator plateand a manifold hole of an outlet sideA channel of fuel gas which is formed in a field which touches one electrode of a conductive separator plateand connects the entrance side of fuel gasand an exit side manifold holeAnd it is provided in a field which touches an electrode of another side of a conductive separator plateand a channel of oxidant gas which connects the entrance side of oxidant gas and an exit side manifold hole is providedA polyelectrolyte type fuel cell providing a layer of electric insulation material in a peripheral edge part of a side which touches an electrolyte membrane-electrode conjugate of said conductive separator plate.

[Claim 2]The entrance side of cooling water opened for free passage and formed in said electrolyte membrane-electrode conjugate and a conductive separator plate and a manifold hole of an outlet side are providedThe cathode side separator board with which at least some conductive separator plates have a

channel of oxidant gas in one fieldand have a channel of cooling water which connects the entrance side of said cooling waterand an exit side manifold hole to a field of another sideThe anode side separator board which has a channel of fuel gas in one fieldand has a channel of cooling water which connects the entrance side of said cooling waterand an exit side manifold hole to a field of another sideThe polyelectrolyte type fuel cell according to claim 1 which has fitted in mutually in a projected part which opposed a channel of said cooling waterwas joined and constitutedand formed the cathode side separator board and the anode side separator board in one sideand a crevice established in another side.

[Claim 3]The polyelectrolyte type fuel cell according to claim 1 or 2 with which said conductive separator plate and a gasket have fitted in mutually in a projected part provided in one sideand a crevice established in another side.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to the fuel cell using the solid polymer electrolyte used for a portable power supplythe power supply for electromobilesa domestic cogeneration systemetc.

[0002]

[Description of the Prior Art]The fuel cell using a solid polymer electrolyte is making the fuel gas containing hydrogenand the fuel gas containing oxygensuch as airreact electrochemicallyand generates electric power and heat simultaneously. Fundamentallythis fuel cell comprises the electrodei.e.the anodeand cathode of the couple formed in both sides of the polymer electrolyte membrane which conveys a hydrogen ion selectivelyand polymer electrolyte membrane. The aforementioned electrode usually uses as the main ingredients

carbon powder which supported the platinum metal catalystand consists of a catalyst bed formed on the surface of polymer electrolyte membraneand a diffusion zone having breathability and electron conductivity formed in the outside surface of this catalyst bed.

[0003]The fuel gas and oxidant gas which are supplied to an electrode leak outsideor around an electrodegas-seal material and a gasket are arranged on both sides of polymer electrolyte membrane so that two kinds of gas may not be mixed mutually. It unites with an electrode and polymer electrolyte membraneand this sealant and gasket are assembled beforehand. This is called MEA (electrolyte membrane-electrode conjugate). The conductive separator board for mutually electrically connecting adjoining MEA to it in serieswhile fixing this to the outside of MEA mechanically is arranged. Reactant gas is supplied to an electrode surface and the gas passageway for carrying away production gas and excess gas is formed in the portion in contact with MEA of a separator board. Although a gas passageway can also be provided apart from a separator boardthe system which provides a slot on the surface of a separator boardand is made into a gas passageway is common. In order to supply reactant gas to this slotit branches in the number of sheets of the separator board which uses piping which supplies gasand the piping jig which connects that branching destination with the slot of a direct separator board is needed. This fixture is called a manifold and an external manifold is called for the type connected directly from the charging line of the above gas. There is a thing of the form called the internal manifold which simplified structure more in this manifold. An internal manifold provides the penetrated hole in the separator board in which the gas passageway was formedand supplies direct reaction gas for the entrance of a gas passageway to it from through and this hole to this hole.

[0004]Since a fuel cell generates heat during operationin order to maintain a cell to a good temperature stateit is necessary to cool by cooling water etc. Usuallythe cooling unit which pours cooling water every one to 3 cell is provided. There are form which inserts a cooling unit between separator boardsand form

which establishes a circulating-water-flow way in the back of a separator boardand is used as a cooling unitand many latters are used. These MEA(s) and separator boardsand a cooling unit are piled up by turnsand after carrying out 10-200 cell laminationthe structure of a common layer built cell inserts with an end plate via a collecting electrode plate and an electric insulating plateand fixes end plates with fastening bolt. In such a polyelectrolyte type fuel cellconductivity of a separator board is highand its airtightness is high to reactant gasand also it needs to have high corrosion resistance to the reaction at the time of carrying out oxidation reduction of hydrogen/the oxygen. Since it is sucha separator board usually comprises carbon materialssuch as isotropic graphite and expanded graphiteand it is produced by molding according [cutting in the surface and the case of expanded graphite] to a mold also in a gas passageway etc.

[0005]

[Problem to be solved by the invention]In the conventional conductive separator plate and the fuel cell which laminated MEA mentioned abovesince the conductive separator plate is made from carbonit may be weak in intensity and may lead to breakage of a conductive separator plate depending on how to treat. When the maximum outside dimension of MEA is smaller than the maximum outside dimension of a conductive separator platein the conductive separator plate of a fuel cell and the end of the lamination portion of MEA setting up was finisheda very small crevice occurs between the conductive separator plates which sandwich MEA. And if conductive separator plates contact via the crevicea short circuit will occurthere will also be fear of ignition and generation of heatand it will become a dangerous situation. When laminating and finishing setting up a conductive separator plate with the cell of a fuel cellonly by laminating simplythe alignment of a conductive separator plate is difficult and needed the large-scale fixture for a fuel cell assembly.

[0006]

[Means for solving problem]This invention is providing a layer of electric insulation material in a peripheral edge part which laps with the field side in which

a slot for gas passagewaies on the conductive separator plate was established with gasket parts of MEA laminatedwhen finishing setting up a fuel cellWhile raising intensity of a conductive separator platea fuel cell of structure which a very small short circuit does not produce even if the ends of a conductive separator plate which adjoins via MEA contact is provided. Alignment of a conductive separator plate laminated at the time of a fuel cell assembly and MEA is made easy by giving fitting structure to a peripheral edge part of a conductive separator plate.

[0007]An electrode of a couple which has a catalyst bed into which a polyelectrolyte type fuel cell of this invention inserts polymer electrolyte membrane and said polymer electrolyteAnd two or more electrolyte membrane-electrode conjugates which consist of a gasket arranged in a peripheral edge part of said electrodeTwo or more conductive separator plates which put in said electrolyte membrane-electrode conjugate in between and were laminated by turnsThe entrance side of fuel gas and oxidant gas which were opened for free passage and formed in said electrolyte membrane-electrode conjugate and a conductive separator plateand a manifold hole of an outlet sideA channel of fuel gas which is formed in a field which touches one electrode of a conductive separator plateand connects the entrance side of fuel gasand an exit side manifold holeAnd it was provided in a field which touches an electrode of another side of a conductive separator plateand a channel of oxidant gas which connects the entrance side of oxidant gas and an exit side manifold hole was providedand a layer of electric insulation material was provided in a peripheral edge part of a side which touches an electrolyte membrane-electrode conjugate of said conductive separator plate.

[0008]The entrance side of the cooling water opened for free passage and formed in said electrolyte membrane-electrode conjugate and the conductive separator plate and the manifold hole of an outlet side are providedThe cathode side separator board with which at least some conductive separator plates have a channel of oxidant gas in one fieldand have a channel of the cooling water

which connects the entrance side of said cooling waterand an exit side manifold hole to the field of another sideThe anode side separator board which has a channel of fuel gas in one fieldand has a channel of the cooling water which connects the entrance side of said cooling waterand an exit side manifold hole to the field of another sideThe channel of said cooling water is opposedit is joined and constitutedandas for the cathode side separator board and the anode side separator boardit is preferred to have fitted in mutually in the projected part provided in one side and the crevice established in another side. As for said conductive separator plate and a gasketit is preferred to have fitted in mutually in the projected part provided in one side and the crevice established in another side.

[0009]

[Mode for carrying out the invention]Hereafteran embodiment of the invention is describedreferring to Drawings.

[0010]Embodiment 1 drawing 1 is a front view by the side of the anode of a polymer-electrolyte-membrane-electrode conjugate (MEA)As for the cathode side conductive separator platedrawing 6and drawing 7the single separator board with which drawing 2 and drawing 3 serve both as the cathode side conductive separator plate and the anode side conductive separator platedrawing 4and drawing 5 show the anode side conductive separator platerespectively. Drawing 8 is a sectional view of the important section of the laminated fuel cell. These figures are for explaining structure and the relative size or position of each element are not necessarily exact.

[0011]MEA5 comprises the cathode 2 which sandwiches the polymer electrolyte membrane 1 and this and the anode 3and the gasket 4 arranged to the peripheral edge part of these each electrode. The conductive separator plate which carries out this MEA5 in between and is laminated MEA and by turnsTwo sorts of the complex separator board which combined the cathode side conductive separator plate 20 for constituting the single separator board 10 which serves both as the cathode side conductive separator plate and the anode

side conductive separator plateand a cooling unitand the anode side conductive separator plate 30 were used. As shown in drawing 1MEA5 penetrates the gasket 4 and polymer electrolyte membraneand it has oxidant gasfuel gasand the manifold holes 78and 9 of one pair each of each of cooling water. These manifold holes are open for free passage with the manifold hole established in the below-mentioned conductive separator plate. And in one sideanother side serves as [an entrance side] an outlet side among the manifold holes of a couple. The separator board 10 has the manifold hole 11 of oxidant gasthe manifold hole 12 of fuel gasand the manifold hole 15 of cooling wateras shown in drawing 2 and drawing 3In the field which touches the anode 3 in the channel 13 of oxidant gas again so that the entrance side manifold hole and exit side manifold hole of oxidant gas may be connectedit has the channel 14 of fuel gas in the field which touches the cathode 2 so that the entrance side manifold hole and exit side manifold hole of fuel gas may be connected. And in a double-sided peripheral edge partit has the layer 17 which consists of insulating materials. In order to make it intelligible by a diagramthe slash is given to the portion of the layer 17 of an insulating material. The layers 27 and 37 of the insulating material described below attach the slash similarly.

[0012]As shown in drawing 4 and drawing 5the cathode side conductive separator plate 20It has the manifold hole 21 of oxidant gasthe manifold hole 22 of fuel gasand the manifold hole 25 of cooling waterIn the field which touches the cathode 2it has the channel 26 of cooling water so that it may inform the field of an opposite hand again that the entrance side manifold hole and exit side manifold hole of cooling water connect the entrance side manifold hole and exit side manifold hole of oxidant gas for the channel 23 of oxidant gas. And in the peripheral edge part of the field which touches a cathodeit has the layer 27 which consists of insulating materials. As shown in drawing 6 and drawing 7the anode side conductive separator plate 30It has the manifold hole 31 of oxidant gasthe manifold hole 32 of fuel gasand the manifold hole 35 of cooling waterIn the field which touches the anode 3it has the channel 36 of cooling water so that it may

inform the field of an opposite hand again that the entrance side manifold hole and exit side manifold hole of cooling water connect the entrance side manifold hole and exit side manifold hole of fuel gas for the channel 34 of fuel gas. And in the peripheral edge part of the field which touches an anodeit has the layer 37 which consists of insulating materials.

[0013]These cathode side conductive separator plate 20 and the anode side conductive separator plate 30 oppose a field which has a channel of cooling waterare joineda complex separator board is constitutedand a channel of cooling water comprises the channels 26 and 36. Thereforea channel of cooling water of one separator board may be excluded. The gas-seal nature of a junction with the separator boards 20 and 30 is secured by pasting together by a liquefied sealing compound suitably.

[0014]The above separator board 10 and a complex separator board which combined the separator boards 20 and 30 are arranged by turnsand a layer built cell as inserted MEA5 between them and shown in drawing 8 is assembled. Arrangement of these separator boards is not restricted to an example of a graphic display. When the maximum outside dimension of MEA is smaller than the maximum outside dimension of a conductive separator platein a conductive separator plate of a fuel cell and an end of a lamination portion of MEA setting up was finisheda very small crevice occurs between conductive separator plates which sandwich MEA. Howeversince the layer 17 of an insulating materialand 27 and 37 are provided in a peripheral edge part of a field which touches MEA of a separator board so that clearly from drawing 8a short circuit is not produced even if the peripheral edge parts of a separator board may contact.

[0015]A separator board is constituted from a carbon material as usualand forms a gas passageway with cutting or shaping with a mold. The layer of the insulating material formed in the peripheral edge part of this separator board joins to a separator board what used tabular beforehand and cut this to prescribed size at one by the method of pasting together to a separator boardthe method of carrying out molding to a separator boardetc. Various engineering plastics can be

used for an insulating material. In order to compensate the intensity of the separator board made from carbon especiallyit is good to use the plastic of glass fiber etc. entering a filler. When using metal for separator board materialthe insulating material does not need to take intensity into consideration.

[0016]The cathode side separator board 20a which constitutes the complex separator board in a two embodiment embodimentand the anode side separator board 30a are shown in drawing 9 and drawing 10respectively. The cathode side separator board 20a has the projected part 28 in two places of the field which has the channel 26 of cooling waterand has a crevice at this and the corresponding rear faceand also it is the same structure as the cathode side separator board 20. The anode side separator board 30a has the crevice 39 which fits into the aforementioned projected part 28 in two places of the field which has the channel 36 of cooling waterand has a projected part at this and the corresponding rear faceand also it is the same structure as the anode side separator board 30. These separator boards 20a and 30a are combined so that the former projected part 28 may fit into the latter crevice 39and a complex separator board is constituted. The sealing nature in the junction of the separator boards 20a and 30a is secured by pasting together by a liquefied sealing compound suitably like the case of Embodiment 1.

[0017]The projected part is formed in the field which has a channel of fuel gas in the separator board 30a of this complex separator board corresponding to the crevice 39. The crevice established in the gasket in contact with this is made to carry out fitting of this projected part. In the field which has a channel of the oxidant gas of the separator board 20ait has a crevice corresponding to the projected part 28. This crevice is made to carry out fitting of the projected part provided in the adjoining gasket. Thusit not only provides and carries out fitting of the projected part and crevice which fit in mutually to the cathode side separator board which constitutes a complex separator boardand the anode side separator boardbut it can establish the projected part and crevice which fit in mutually in a separator board and MEA. By thisposition ****** for an assembly of a layer built

cell becomes certain.

[0018]

[Working example]<<Working example 1>> In this examplethe polyelectrolyte type fuel cell of the structure shown in Embodiment 1 was produced. Firstthe conductive separator plates 1020and 30 were formed by compression molding with the charge of an expanded graphite material. Outside dimensions are 2 mm in thickness130 mm in heightand 260 mm in width.

The slot for gas passagewaies a 2.9-mm pitch and about 2 mm in width was formed in the cathode and the anodeand the field that counters at the time of shaping to the field of 20 cm x 9 cm of center sections of the separator board. The slot for channels on the cooling water was a pitch of 2.9 mmand about 2 mm in width. Oxidant gasfuel gasand the manifold hole of cooling water were provided at the time of compression molding. In this waythe layer of polyphenylene sulfide resin containing glass fiber was stuck on the outer peripheral part of the fabricated separator board. The layer of this insulating material pierced and produced what was beforehand made into the film state of 0.5-mm thickness. The peripheral edge part on which the aforementioned separator board made from carbon sticks the layer of this insulating material was 1.0 mm in thickness.

[0019]The position of the slot for channels on the oxidant gas and the slot for channels on the fuel gas in the separator board 10 is constituted so that it may correspondand superfluous shearing force was kept from requiring for an electrode. The separator boards 20 and 30 which constitute a cooling unit were pasted together by the sealing compound so that the channel of cooling water might face each other. The liquefied gasket (Toray Industries Dow Corning silicone incorporated company: SE9186L) was used for the sealing compound.

[0020]On the other handwhat supported the platinum particle with a mean particle diameter of about 30 A with the rate of the weight ratio 75:25 to acetylene black system carbon powder was made into the electrode catalyst. Isopropanol was made to distribute this catalyst powderthe ethyl alcohol dispersion liquid of

the powder of the perfluorocarbon sulfonic acid shown in a formula (1) at this were mixedand it was made paste state. It was with screen printing by having used this paste as the raw materialand the electrode catalyst layer was formed in one field of a 250-micrometer-thick carbon nonwoven fabric. It was madeas for the amount of platinum contained in this catalyst bedfor the quantity of 0.5mg/cm² and perfluorocarbon sulfonic acid to become 1.2mg[/cm] ².

[0021]

[Chemical formula 1]

[0022]It is 5<=x<=13.5y**1000m= 1and n= 2 among a formula. In this waythe produced electrode made the cathode and the anode the identical configurationand to both sides of the central part of the proton conductivity polymer electrolyte membrane which has a somewhat larger area than an electrodeit joined with the hotpress so that the printed catalyst bed might touch the electrolyte membrane sideand it produced MEA to them. What thin-film-ized the perfluorocarbon sulfonic acid expressed with a formula (1) (however5<=x<=13.5y**1000m= 2n= 2) in thickness of 25 micrometers was used for polymer electrolyte membrane. The gasket made of resin which has elasticity was stuck on the electrode peripheral edge part which the electrolyte membrane exposed.

[0023]50 sets of MEA(s) shown above were laminated via the separator boardthe layered product was inserted with the end plate made from stainless steel of two sheets via the collecting electrode plate and the electric insulating plateand end plates were concluded by the pressure of 10 kgf/cm² by the conclusion rod. When designing the maximum outside dimension of MEA at 129 mm in heightand 259 mm in width at this time and laminating a separator board and MEAthe fixture was pressed against the separator board peripheral endand position ****** was carried out. The polyelectrolyte type fuel cell of this example produced in this way was held at 85 **and the hydrogen gas which humidified

and warmed the air humidified and warmed so that it might become the 78 ** dew point at a cathode so that it might become an anode with the 83 ** dew point was suppliedrespectively. As a resultwhen [no-load] not outputting current outsidethe cell open circuit voltage of 50V was obtained. The short circuit was not detected although the short circuit situation between each separator board was checked at this time.

[0024]

[Effect of the Invention]As mentioned aboveaccording to this inventionby securing the electric insulation in a separator board endeven if it designs the maximum outside dimension of MEA smaller than the maximum outside dimension of a conductive separator plategenerating of a very small short circuit can be prevented. In the conductive separator plate of a fuel cell stackand the lamination portion of MEAposition immobilization in a conductive separator plate peripheral end is attained.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]It is a front view of MEA of the fuel cell in working example of this invention.

[Drawing 2]It is a front view by the side of the cathode of a separator board.

[Drawing 3]It is a rear elevation of the separator board.

[Drawing 4]It is a front view of the cathode side separator board.

[Drawing 5]It is a rear elevation of the separator board.

[Drawing 6]It is a rear elevation of the anode side separator board.

[Drawing 7]It is a front view of the separator board.

[Drawing 8]It is a sectional view of the important section of the fuel cell in working example of this invention.

[Drawing 9]It is a rear elevation of the cathode side separator board in other

working example of this invention.

[Drawing 10]It is a rear elevation of the anode side separator board of the working example.

[Explanations of letters or numerals]

1 Polymer electrolyte membrane

2 Cathode

3 Anode

4 Gasket

5 MEA

71121the manifold hole of 31 oxidant gas

81222the manifold hole of 32 fuel gas

91525and 35 Manifold hole of cooling water

The channel of 1323and 33 oxidant gas

The channel of 1424and 34 fuel gas

1626and 36 Channel of cooling water

1727and 37 Layer of an insulating material

28 Projected part

39 Crevice